

**A COMPARATIVE STUDY ON  $^{137}\text{Cs}$  TRANSFER FROM  
SOIL TO VEGETATION IN THE MARSHALL ISLANDS**

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Bikini and Enewetak Atoll form part of the Marshall Islands chain in the equatorial Pacific Ocean, and were used by the United States as testing grounds for nuclear weapons (1946-58). Many of the near-surface tests conducted over islands or shallow water produced highly localized inputs leading to contamination of islands/atolls within the northern Marshall Islands above that expected from global fallout deposition. The most notable event of the entire Pacific test series was the BRAVO shot of 1 March 1954. BRAVO had an estimated explosive yield of 15 MT, and produced wide-spread contamination over Bikini Atoll and several islands/atolls east of Bikini.

The Lawrence Livermore National Laboratory has conducted a high-profile radioecology and dose assessment program in the Marshall Islands since 1973. Environmental characterization and radionuclide monitoring are used as a basis for improving estimates of the potential radiological dose at Bikini, Enewetak, Rongelap, Utirik, and other atolls. Since the early 1970's, we have collected up to several thousand environmental samples (including vegetation, soils, water and aerosols samples) on an annual basis for detailed radiometric analysis, and to study rates of radionuclide uptake, redistribution, resuspension, and removal in atoll ecosystems. Cesium-137 ( $^{137}\text{Cs}$ ) contributes up to 95% of the estimated dose via ingestion. The major dietary pathway for  $^{137}\text{Cs}$  uptake is through consumption of coconut and other locally grown food crops such as *Pandanus*, breadfruit, and papaya. As such, our studies have focused on the need to develop a good understanding of  $^{137}\text{Cs}$  transfer from soil to plants, and to examine potential remedial measures to reduce doses to resident populations. This paper provides a summary of data on the uptake of  $^{137}\text{Cs}$  by plants described by a concentration ratio (CR) or soil-to-plant transfer factor—defined by the ratio of radionuclide concentration in vegetation and soil (in  $\text{Bq kg}^{-1}$  dry weight plant to  $\text{Bq kg}^{-1}$  dry weight soil) normalized to a depth interval of

0-40 cm. The coralline soils of the Marshall Islands are composed almost entirely of calcium (Ca) carbonate with lesser amounts of magnesium (Mg) carbonate and essentially little or no aluminosilicate material. The soils are also very low in exchangeable potassium (K). We consider successively the variation of CR values between different plants (largely foodcrops), the spatial variation of CR values between atolls, the unique properties of soils in the Marshall Islands, as compared with those found in more temperate zones, and the importance of available K on  $^{137}\text{Cs}$  uptake.

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